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(71) Applicant(s)
3Com Technologies
(Incorporated in the Cayman Islands)
PO Box 309, Upland House, Georgetown,
Grand Cayman, Cayman Islands
(72) Inventor(s)
Richard McBride
(74) Agent and/or Address for Service
Bowles Horton
Felden House, Dower Mews, High Street,
BERKHAMSTED, Herts, HP4 2BL, United Kingdom

(54) Abstract Title
Establishing packet-switched telephone calls using circuit switched signalling

(57) A telephone instrument 1,2 comprises means for providing signals for transmission, means for converting signals received by the instrument into output signals, a switching circuit for selectively establishing and terminating a connection between the instrument and a circuit-switched telephone network and for selectively establishing and terminating a connection between the instrument and a packet-switched communication network 4. When calling, the instrument signals over the circuit-switched network for the called instrument's network address on the packet-switched network and establishes a dual connection over the packet-switched network if such a network address is received. When receiving a call, the instrument can terminate the call connection over the circuit-switched network and continue the call by way of the packet-switched network.

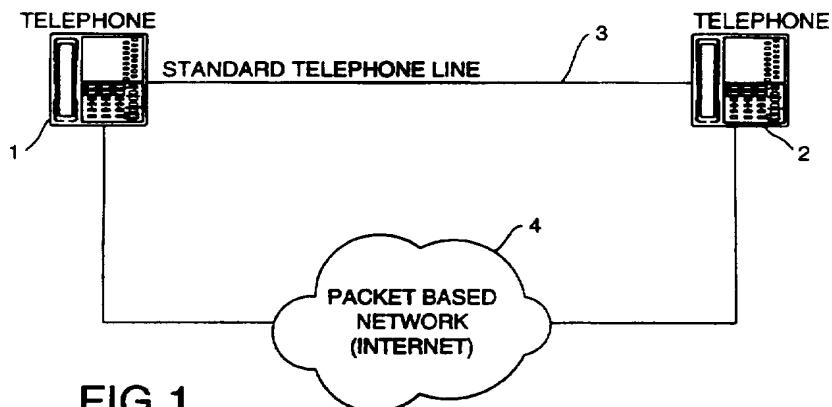


FIG.1

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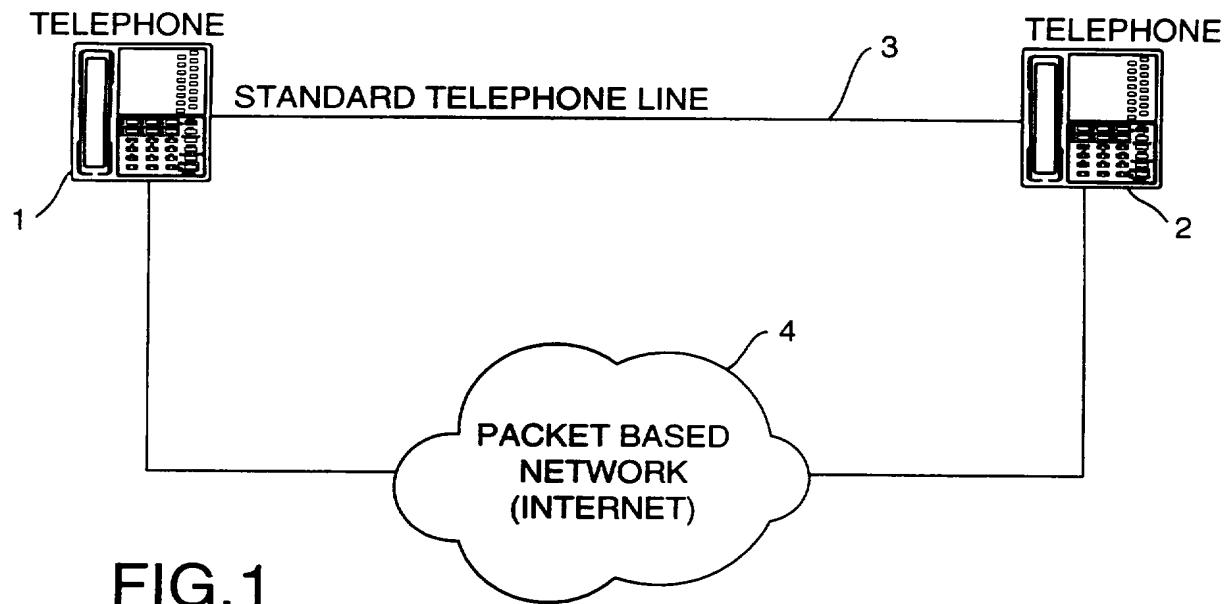


FIG.1

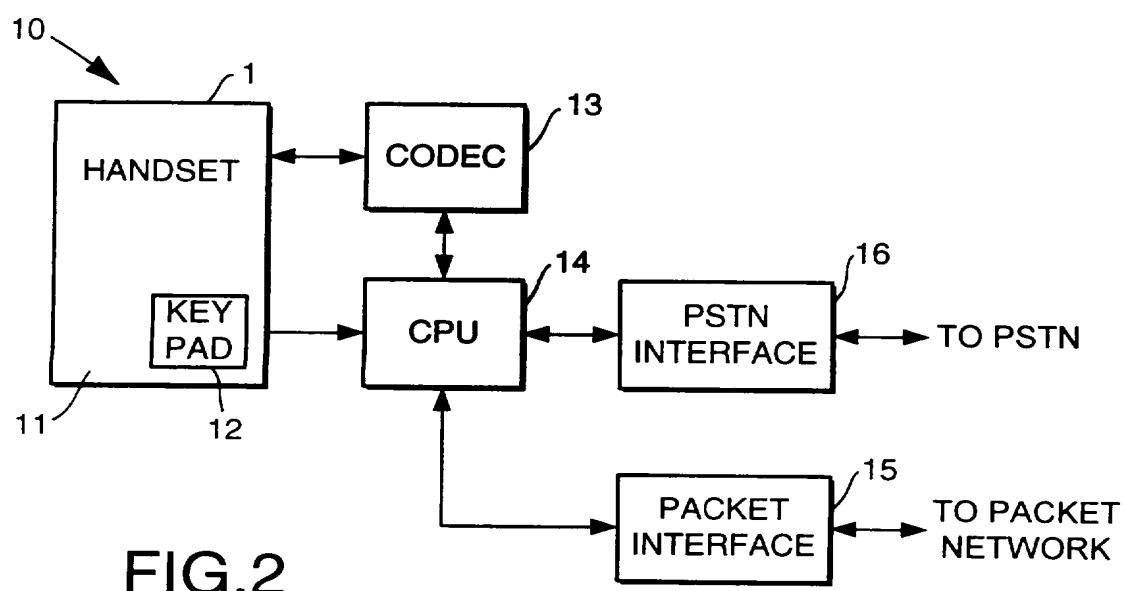


FIG.2

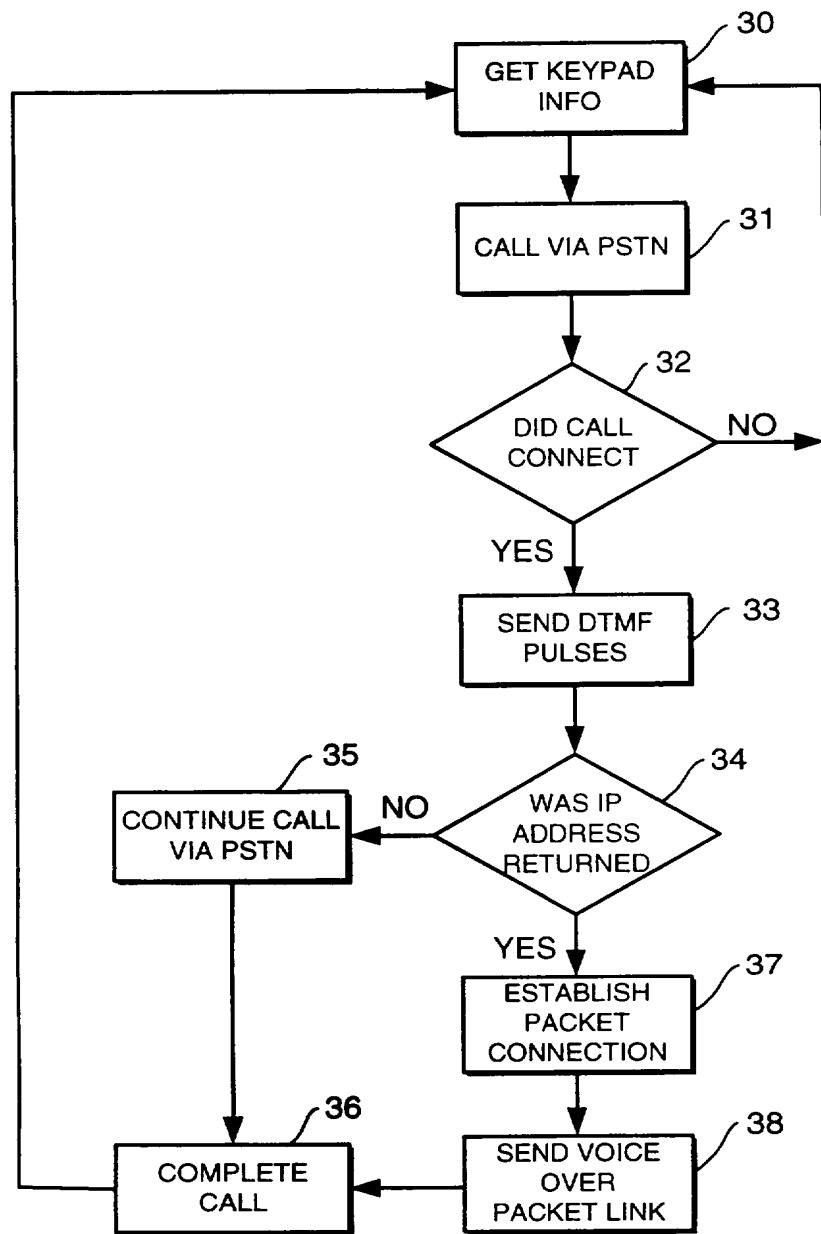


FIG.3

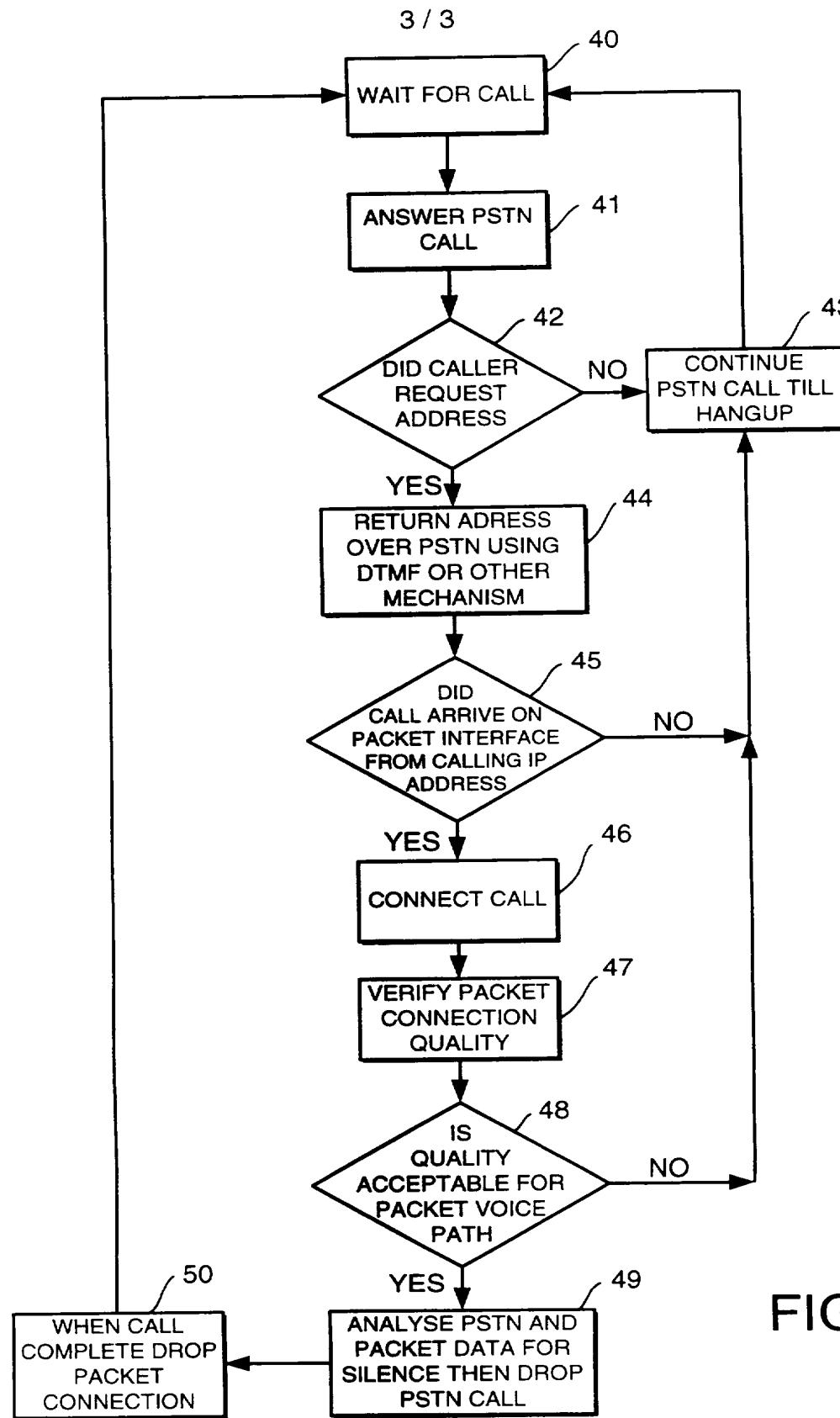


FIG.4

DUAL-CIRCUIT TELEPHONYField of the Invention

5 The present invention relates to telephony and to telephone instruments which have dual circuit capability.

Background to the Invention

10 Most telephone networks in use at the present time are circuit switched networks, in which telephone subscribers have, at least to a local switching station, a dedicated line identified by a subscriber's number. Connection to the network is achieved by a switch closing a circuit including the subscriber line to the local switching station. Telephone calls may be conveyed from switching station to switching station by a variety of links, but connection is established for the call to the ultimate recipient by means of circuit switching controlled by the generation of pulse trains or tones representing the recipient's telephone number. Although telephone messages, whether voice calls or other types of call, such as facsimile transmissions, may be conveyed between switching stations by various time division, frequency division or even packet-switched communication links, as far as the end stations, the telephone instruments, are concerned they make connections to an analog circuit-switched network. Owing to the global nature of the existing circuit-switched networks, their use will obviously continue for many years and telephone instruments are necessarily adapted to establish connections by way of the familiar circuit-switched network.

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25 In recent years there has been increasing use, first in local area networks and then on a wider scale, of packet-switched networks, of which the 'Internet' is the best known. The present invention is based on an appreciation that the usage of packet-switched networks will provide a potential alternative communication link between telephone subscribers.

30 The present invention envisages a new form of telephone instrument, typically a handset capable of making voice calls, which has a dual circuit capability in that it is capable of establishing a call

connection over the ordinary, circuit-switched telephone network but may, if desired automatically, transfer the call connection from the circuit-switched telephone network to a packet-switched network.

5 Summary of the Invention

An instrument according to the invention would normally possess, in common with existing instruments, some means for providing signals for transmission and some means for converting signals received by the instrument into output signals. The aforementioned means may, in the case of a telephone handset instrument, include the usual microphone and loudspeaker and the usual dialling equipment or tone generation equipment by means of which an intended recipient's number can be transmitted in the format required by the circuit-switched network to the local switching station in order to establish a call connection with an intended recipient.

10 An instrument according to the invention will, however, further comprise not only a switching circuit for selectively establishing and terminating a connection between the instrument and the circuit-switched telephone network but further means for selectively establishing and terminating a connection between the instrument and a packet-switched communication network. The switching circuit for this purpose may include appropriate multiplexing equipment interposed between the call generating and receiving circuits and the terminals or connection points for the telephone network and the packet-switched network.

15 Further, the telephone instrument preferably comprises control means including means operable to define or obtain a network address of the instrument in the packet-switched communication network, the control means being operable:

20 (i) to control the switching circuit to establish a call connection to another instrument on the telephone network;

25 (ii) in response to receipt of an acknowledgement signal including the network address of the other instrument to control the switching circuit to make the call connection to the other instrument by way of the packet-switched network.

The instrument may signal information including its network address over the initial call connection. Alternatively, it may obtain its network address only after receipt of the said acknowledgment from the other instrument.

5 The instrument may further comprise control means operable on receipt of a call by way of the circuit-switched network to provide an acknowledgement including the network address of the instrument, and on receipt of a subsequent message over the packet-switched network to terminate connection over the circuit-switched network.

10 Brief Description of the Drawings

Figure 1 is a schematic illustration of two telephones having dual connections;

15 Figure 2 is a schematic drawing of a telephone according to the invention coupled to both a public-switched telephone network and a packet-based network;

Figure 3 illustrates the operation of call logic at a calling station; and

Figure 4 illustrates the operation of call logic at a called or receiving station.

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Detailed Description

Figure 1 illustrates broadly the intended operation of the invention, which assumes the continued existence of the familiar circuit-switched networks. When therefore a calling instrument 25 (hereinafter called 'station') needs to communicate with a second instrument (station) 2, station 1 will initially use a circuit-switched line 3, since there is a presumption that at least in the foreseeable future the remote station 2 will be connected to the public-switched telephone network. If however the called station 2 is connected to a packet-switched network 4 and the calling station 1 is also connected to the packet-switched network, then the call may be completed over the packet-switched network.

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5 Whether a call should be completed over the packet-switched network 4 may be a matter of selection and programming and may also be dependent upon whether the cost of a call per unit time is cheaper or more expensive over the packet-switched network 4 than it is over the ordinary telephone line 3 which proceeds through the public-switched telephone network. It will be assumed in the following that at least the calling instrument or station 1 is configured or programmed to attempt to establish a packet-switched call connection with the remote station 2 if it is feasible to do so.

10 Figure 2 illustrates a calling station 10 which includes a telephone instrument 1 comprising a familiar handset 11 and a keypad 12. The instrument 1 is connected to a voice codec 13 which takes analog signals from the handset, digitizes them and passes the digitized data to a central processing unit (CPU) 14. The CPU may be of the digital signal processor type. It is employed to process signals both from the handset 1 via the voice codec 13 and also a packet interface 15 and to couple signals from a PSTN interface 16. The packet interface may be any one of a variety of packet interfaces, such as an ASDL interface or an Ethernet interface. The packet interface, in this example, transmits Ethernet packets in which the message data is constituted by voice data obtained by way of the voice codec 13 and CPU 14 from the instrument 1.

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20 Figures 3 and 4 illustrate the operation of a station 10 when operating as a calling station and a called or receiving station respectively.

25 In the system broadly shown in Figure 1, and on the assumption that at least telephone 1 is disposed in a station 10 having a facility for communicating by way of the packet-switched network 4, the operation is as follows.

30 User A at station 10 including instrument 1 calls a user B, having telephone 2 by means of obtaining the keypad information entered by the keypad 12 and calling via the public-switched telephone network, as shown at stages 30 and 31 of Figure 3. If the call did not connect (stage 32), a fresh attempt is made to initiate the call (stage 30). In any case, the CPU will collect the digits from the keypad and signal them down the PSTN interface 16 to the public-switched telephone network.

Once a circuit has been established by way of the public-switched network, users A and B will be able to talk over the circuit as in a standard telephone call. Once the call is established, the originating station will attempt to signal the receiving station to establish whether the receiving station has a packet-switched network that could be used for continuing the call. A basic signalling method that will work on all types of public-switched telephone networks is in-band with the voice signal. One method is to employ DTMF signals to send information from A to B, namely a sequence of tones along with the user's voice data which indicates to the receiving station that the sending station 10 is equipped with a secondary packet interface 14. This is shown by stage 33 in Figure 3.

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If the receiving station is not equipped with the logic to respond to the DTMF tones, the sending station will continue to communicate over the PSTN network, as shown by stages 35 until the call is completed (stage 36). If however the receiving station is equipped with the appropriate logic, it can respond to the sending station by indicating the network address on the packet network (stage 34). This address might be fixed and unchanging or might be assigned dynamically in some way. One known method to assign addresses dynamically is to have the station communicate to a centralized entity that will use a protocol to communicate to calling station a free address. This communication of the address (however allotted) of the receiving station B is communicated over the packet-switched network to the packet interface 15 and the CPU 14. This is shown by stage 34 in Figure 3.

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Once the called station has responded to the calling station with its packet network address the calling station can attempt to obtain a connection over the packet network. Using the packet network address obtained from the called station, the calling station will attempt to connect over the packet network. If the calling station can establish a connection then digitized voice data may be sent from instrument 1 by voice codec 13 and CPU 14 over the packet network. Optionally, the called station can verify the quality of the packet link to see whether it is adequate for both voice calls. The quality check may determine latency, jitter, reliability or some other attribute of the link.

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30 Thus as shown in Figure 3, there is establishment of the packet connection at stage 37 and the sending of voice data over the packet link (stage 38) until the call is completed.

With two links established, one over the circuit-switched network and one over the packet-based network, the called station can decide which route to choose. A variety of methods may be used to perform the changeover from voice on the public-switched telephone network to voice data on the packet network. For example, the called station may determine when it is appropriate to switch over from the packet-switched telephone network to the packet network. The called station will analyse the voice information arriving on the packet-switched telephone network interface and wait for silence in the voice call. At this point the voice information that is arriving on the packet interface can be sent to the handset without the user being aware of the switch-over. At this point the packet-switched telephone network call can be terminated and the remainder of the call connection can continue over the packet network.

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Thus, as shown in Figure 4, the station 4 logic operates as follows.

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Stage 40 indicates the rest state where the station is waiting for a call. Stage 41 indicates the answering of the call over the public-switched telephone network. Stage 42 performed in the CPU 14 requires a determination of whether the caller requested the network address of the station. If no such request was made, the call over the public-switched telephone network is continued until the call is terminated (stage 43).

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If the caller requested the network address for the called instrument, the address is returned (stage 44) over the public-switched telephone network using DTMF tones or other mechanism.

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If the call arrived on the packet interface from the calling IP address (stage 43) the call is connected over the packet network (stage 46). The connection quality of the packet is verified (stage 47) and there is a further determination to see whether the quality is acceptable for the packet voice path (stage 48). If the call did not arrive from the packet interface from the calling IP address or the voice quality is not acceptable for the packet voice path, the call continues over the public-switched telephone network until hang-up. If however the call did arrive on the packet-based network and the voice quality is acceptable for the packet voice path, the called station analyses the public-switched telephone network and packet data for silence (stage 49) and then terminates the call over the public-switched telephone network by operation of the CPU until the call is complete, when the packet connection is dropped (stage 50).

30

CLAIMS

1. A telephone instrument comprising:

5 means for providing signals for transmission;

means for converting signals received by the instrument into output signals;

10 means for selectively establishing and terminating a connection between another telephone instrument by way of a circuit-switched telephone network and for selectively establishing and terminating a connection between the instrument and a packet-switched communication network; and

15 control means operable:

(i) to signal over the circuit-switched network a request to said another instrument for a network address on the packet-switched network; and

20 (ii) in response to receipt of an acknowledgement signal including a network address for said another instrument to establish a connection to the said other instrument by way of said packet-switched network.

25 2. A telephone instrument according to claim 1 and operable to signal by way of the call connection by way of the circuit-switched network information including the packet-switched network address of the instrument.

3. A telephone instrument according to claim 1 wherein the control means is also operable:

30 on receipt of a call by way of the circuit-switched network to provide an acknowledgement including the network address of the instrument; and

on receipt of a consequent message over the packet-switched network to terminate connection

to the circuit-switched network and to transfer the call to the packet-switched network connection.

4. A telephone instrument according to claim 3 wherein the control means is operable to test
5 the quality of the call connection over the packet-switched network before terminating the call
connection over the circuit-switched network.

5. A telephone instrument according to claim 3 wherein the control means is operable to detect
10 temporary silence in the call connection over at least the circuit-switched network before
terminating the call connection over the circuit-switched network.

6. A telephone instrument comprising:

means for providing audio signals for transmission;

15 means for converting signals received by the instrument into output signals;

means for selectively establishing and terminating a call connection with another telephone
instrument by way of a circuit-switched telephone network and for selectively establishing and
20 terminating a connection with a packet-switched communication network; and

control means operable:

(i) on receipt of a request signal sent over the circuit-switched network for an address of the
25 instrument on the packet-switched network to signal said address over said circuit-switched
network,

(ii) to convey receive call information from said another instrument both by way of said circuit-
switched network and said packet-switched network; and

30 (iii) selectively to terminate a call connection over the circuit-switched network and to continue
the call connection over the packet-switched network.



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Claims searched: 1 to 6

Examiner: Jared Stokes
Date of search: 27 April 1999

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.Q): H4K (KOA, KBHX)

Int Cl (Ed.6): H04M (1/00, 7/00)

Other: On-Line - WPI, EPODOC

Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
A	WO 98/05145 A1 (Weingarten) See page 6 lines 1-14, page 15 line 15-page 18 line 8	-

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.